Road & Bridge Design Publications

Monthly Update – May 2022

Revisions for the month of **May** are listed and displayed below and will be included in projects submitted for the **September** letting. The special detail index from April will remain in effect.

E-mail road related questions to MDOT-Road-Design-Standards@michigan.gov.
E-mail bridge related questions to MDOT-Bridge-Design-Standards@michigan.gov.

Road Design Manual

3.02: Definition of Terms: Revised the definition of "crash analysis" to a predictive, Highway Safety Manual analysis.

3.08.01E & F: Crash Analysis: Revised the requirements for Project & DE/DV crash analyses. (Either a site-specific, predictive, Highway Safety Manual crash analysis or an analysis using the most recent five years of crash data from RoadSoft.)

3.09.03C6: 3R Minimum Guidelines: Made minor revisions to the sections.

3.11.01: General: Added language for experiencing higher than normal crashes in an area.

3.12: Underclearances: Updated links in the section and updated the contact person for Interstate Vertical Clearance Exception Coordination. Also clarified Interstate requirements for Interstate Vertical Clearance Exception Coordination.

7.01.11: Current Clear Zone Criteria: Added language for experiencing higher than normal crashes in an area.

13.02.08: Clearing and Removing Trees on Freeway 4R Projects: Revised the required crash history to include a five-year period.

14.11: Design Exceptions/Variances: Revised "crash analysis" to "predictive, Highway Safety Manual Crash Analysis".

14.24: Request for Crash Analysis and Safety Review: Revisions were made to the section including deleted exception for CPM projects and updating the crash analysis if it is more than three years old.

Road & Bridge Design Publications

Monthly Update – May 2022

Bridge Design Manual

7.01.08 (LFD & LRFD): Updated various links in the section and updated the contact person for Interstate Vertical Clearance Exception Coordination. Also clarified Interstate requirements for Interstate Vertical Clearance Exception Coordination.

Updates to the MDOT Cell Library, Sample Plans, and other automated tools may be required in tandem with some of this month's updates. Until such updates can be made, it is the designer's/detailer's responsibility to manually incorporate any necessary revisions to notes and plan details to reflect these revisions.

MICHIGAN DESIGN MANUAL
ROAD DESIGN

CHAPTER 3

ALIGNMENT AND GEOMETRICS

3.01 (revised 3-21-2016)

REFERENCES

A. ***A Policy on Design Standards - Interstate System***, AASHTO, 2005

B. ***A Policy on Geometric Design of Highways and Streets***, AASHTO, 2011 6th Edition

C. ***Highway Capacity Manual***, 2000, published by Transportation Research Board, National Research Council.

D. MDOT Geometric Design Guides

E. ***Michigan Manual of Uniform Traffic Control Devices***, current edition, by the Michigan Department of Transportation

F. ***Roadside Design Guide***, AASHTO, 2006

G. Standard Plan R-107-Series, Superelevation and Pavement Crowns

H. MDOT Sight Distance Guidelines

3.02 (revised 5-23-2022)

DEFINITION OF TERMS

Acceleration Lane - An auxiliary lane, including tapers, for the acceleration of vehicles entering another roadway.

Arterial Road – A roadway which provides a high speed, high volume, network for travel between major points.

Auxiliary Lane – Portion of the roadway adjoining the traveled way for speed change, turning, storage for turning, weaving, truck climbing, passing and other purposes supplementary to through-traffic movement.

Average Daily Traffic (ADT) - The average 24 hour traffic volume, based on a yearly total.

Broken Back Curve - Two curves in the same direction joined by a short tangent distance.

Compound Curve - Two connecting horizontal curves in the same direction having different radii.

Collector Road – Roadway linking a Local Road to an Arterial Road, usually serving moderate traffic volumes.

Crash Analysis - A site specific, predictive Highway Safety Manual safety review of crash data performed to identify whether or not a specific geometric design element has either caused or contributed to, or could cause or contribute to a pattern or concentration of crashes at the location in question. The analysis is a critical component used in determining the appropriate application of geometric design criteria and in the evaluation of design exception / variance approval requests.

3.08

3R, 4R AND OTHER PROJECTS

3.08.01 (revised 5-23-2022)

General

A. (3R) Resurfacing Restoration and Rehabilitation

This work is defined in 23 CFR (Code of Federal Regulations) as "*work undertaken to extend the service life of an existing highway and enhance highway safety. This includes placement of additional surface material and/or other work necessary to return an existing roadway, including shoulders, bridges, the roadside and appurtenances to a condition of structural or functional adequacy. This work may include upgrading of geometric features, such as widening, flattening curves or improving sight distances*." Examples of this type of work include:

1. Resurfacing, milling or profiling, concrete overlays and inlays (without removing subbase).
2. Lane and/or shoulder widening (no increase in number of through lanes).
3. Roadway base correction.
4. Minor alignment improvements.
5. Roadside safety improvements.
6. Signing, pavement marking and traffic signals.
7. Intersection and railroad crossing upgrades.
8. Pavement joint repair.
9. Crush and shape and resurfacing.
10. Rubblize and resurface.

3.08.01A (continued)

11. Intermittent grade modifications (used to correct deficiencies in the vertical alignment by changing the paving profile for short distances) that leave the existing pavement in service for more than 50% of the total project length.
12. Passing relief lanes.

See Chapter 12 of the Bridge Design Manual for examples of “bridge” 3R work.

B. (4R) New Construction/ Reconstruction

Projects that are mainly comprised of the following types of work are not considered 3R.

1. Complete removal and replacement of pavement (including subbase).
2. Major alignment improvements.
3. Adding lanes for through traffic.
4. New roadways and /or bridges.
5. Complete bridge deck or superstructure replacement.
6. Intermittent grade modifications (used to correct deficiencies in the vertical alignment by changing the paving profile for short distances) that leave the existing pavement in service for less than 50% of the total project length.

The above lists are not all inclusive, but are intended to give typical examples of 3R and 4R work.

3.08.01 (continued)

General

E. Design Exceptions / Variances

The sections to follow include standards for geometric design elements for the various classifications of roadways and work types. For specific controlling geometric design elements, a formal design exception must be submitted and approved when the standards cannot be met. Other specific elements and conditions will require a less formal design variance when standards cannot be met.

3.08.01 (continued)

During the review process the Geometric Design Unit will review plans and identify the need for Design Exceptions (DE) or Design Variances (DV) when standards are not met for specified geometric design elements. These elements are listed below with their corresponding level of documentation and/or approval.

Non-Standard Design Element (NHS and Non-NHS) (See Section 3.11.01 for DE Criteria for 3R freeway work)	Applicability of Design Exception (DE) Design Variance (DV)	
	Design Speed	
	≥ 50 MPH	< 50 MPH
Design Speed < Posted Speed	DE	DE
Lane Width*	DE	DV
Shoulder Width	DE	DV
Horizontal Curve Radius*	DE	DV
Superelevation Rate*	DE	DV
Superelevation Transition*	DV	DV
Maximum Grade*	DE	DV
Stopping Sight Distance (Horizontal and Vertical)*	DE	DV
Cross Slope	DE	DV
Vertical Clearance	DE	DE
Design Loading Structural Capacity	DE	DE
Ramp Acceleration / Deceleration Length*	DV	DV

**Values based on design speeds less than posted.*

3.08.01 (continued)

General

Design Exception (DE) - Design Exception requests are submitted on Form DE26 and require approval by the Engineer of Road Design or the Chief Structure Design Engineer. With the exception of low speed (< 50 mph) vertical clearance DE's, subsequent FHWA approval is required for DE elements specifically designated for federal approval in the Risk Based Project Involvement Stewardship and Oversight (RBPI S&O) plan. Design exceptions should be addressed as early in the life of a design as possible, preferably during the scoping process.

Along with the justification for not meeting MDOT and/or AASHTO standards, the design exception shall include a site-specific Predictive Highway Safety Manual (HSM) Crash Analysis and the estimated total cost required to attain full standards compliance. If a specific HSM model does not exist for that roadway type then perform a crash analysis using crash data for the existing conditions. If a specific Crash Modification Factor (CMF) is not available, contact the Traffic and Safety Section for guidance. Utilize the most recent 5 years of crash data available on RoadSoft for the requested Geometric element. The project Crash Analysis or Road Safety Audit (if required) are not applicable for design exceptions. See Section 14.11 for design exception submittal procedures.

3.08.01 (continued)

Design Variance (DV) – Design Variances are submitted on Form DV26. The procedures and conditions of design variances are as follows:

- Crash analysis review on the element in question.
- Simple justification for not meeting standards (cost, ROW, environmental, etc.)
- If the DV involves a geometric element affected by a bridge, coordination with the Bridge Design Supervising Engineer is required.
- The DV is signed by the Associate Region Engineer of Development affirming that the DV is appropriate.
- The signed DV in ProjectWise completes the DV process.

During QA review of final plan package, if a DV is needed and not provided, the project will not proceed to letting until a DV is provided. If the DV is provided then the project proceeds. Verification must be indicated on the milestone checklist and the CA form.

When a bridge falls within a road project and no work is planned for the bridge, AASHTO "bridges to remain in place" criteria apply to the bridges. See AASHTO publication, ***A Policy on Design Standards-Interstate System,*** 2005 or ***A Policy on Geometric Design of Highways and Streets,*** 2011 6th Edition. If the bridge does not meet the criteria to "remain in place" the Road Designer shall be responsible for submitting any necessary design exceptions or design variances for the bridge.

3.08.01 (continued)

General

F. Safety Review / Crash Analysis

A crash analysis is required for all 3R and 4R projects. The Project Manager should contact the TSC Traffic Engineer during scoping, so that a crash analysis can be performed throughout the project limits. On corridor projects only one analysis that includes roadways and bridges is required. Utilize the most recent 5 years of crash data available on RoadSoft to determine where safety enhancements would be beneficial and supported by the data. Crash Analyses more than 3 years old shall be updated to verify the original results.

A site-specific predictive Highway Safety Manual (HSM) Crash Analysis is required as justification for any design exception or design variance. It is also required in determining appropriate 3R design criteria according to Section 3.09.02A and 3.09.02B. If a specific HSM model does not exist for that roadway type, then perform a crash analysis using the most recent 5 years of crash data available on RoadSoft for the existing conditions and the geometric element in question. Site specific crash analyses more than 3 years old shall be updated to verify the original crash analysis.

3.09.02 (continued)

3R Minimum Guidelines

C. Design Exceptions / Variances

Non-freeway 3R minimum guidelines should be followed on all non-freeway 3R projects, including Heritage Routes. When non-freeway 3R guidelines are not met for any one or more of controlling design elements (See Section 3.08.01E.), a request for an exception or variance should be prepared.

When requesting exceptions or variances to design elements on Heritage Routes, it is important to address the fact that the requested exception is based on historic, economic, or environmental concerns for the preservation of the natural beauty or historic nature of the facility.

D. Section Deleted

E. Stopping Sight Distance

Without crash concentrations and/or other geometric features such as intersections, driveways, lane drops, and horizontal curves warranting consideration, existing vertical and horizontal stopping sight distances corresponding to a speed 0 to 15 mph (0 to 20 mph for vertical stopping sight distance on Non-NHS) less than the project design speed may be retained with a supporting site specific crash analysis. However, consideration should be given to re-grading vertical curves where economically and geometrically feasible. A design exception or variance will not be required when an existing vertical curve is improved to meet 3R guidelines on 3R non-freeway projects, with verification that there is no crash concentration attributed to the curve. However, in the presence of a crash concentration, the curve shall be improved to meet 4R guidelines. When entering sight distance is restricted, an appropriate sign warning of the intersection may be installed, including advisory speed panels as needed.

3.09.02 (continued)

F. Horizontal Curve Radius

Without crash concentrations that warrant revision, existing horizontal curve radii corresponding to a speed 0 to 15 mph less than the project design speed may be retained without further documentation.

If the existing horizontal alignment is retained, the operation and safety should be improved to the extent feasible through other elements such as superelevation modifications, removing adverse crown, and removal of sight obstructions to improve stopping sight distance. When the horizontal alignment does not meet the design speed, applicable traffic control devices should be installed according to the ***Michigan Manual on Uniform Traffic Control Devices***.

3.09.03 (revised 5-23-2022)

3R Non-Freeway Safety Considerations

The following additional information serves as guidance for the review of existing and proposed roadside features. Policies on roadside features are not standards and therefore do not require formal design exceptions / variances. When deviations are necessary, a note should be written for the project file. This would not be subject to formal review or approval, however, a note to the design file shall provide the rationale for appropriate alternatives to these guidelines.

A. Signing

Consideration should be given to upgrading sign reflectivity, supports, and locations.

B. Evaluation of Guardrail and Bridge Rail

1. An onsite inspection of height, length, and overall condition should be done to determine guardrail upgrading needs

2. Existing Type A guardrail will be upgraded to current standards (see Chapter 7) at all locations, except as follows. Type A guardrail which is in good condition may be retained at cul-de-sacs, "T" intersections, and in front of the opening between twin overpassing structures.

3. Blunt ends and turned down endings shall be upgraded to current standard terminals.

4. Unconnected guardrail to bridge rail transitions shall be connected or upgraded to current standards.

5. Existing bridge rail may remain in place if it meets AASHTO static load requirements and has an acceptable crash history. Otherwise, the bridge rail shall be upgraded or retrofitted with thrie beam guardrail. Note that new rail or complete rail replacement shall meet current standards. See Bridge Design Manual Section 12.05.

6. By Federal mandate, existing Breakaway Cable Terminals (BCT) must be removed on 3R projects on the National Highway System (NHS). See Section 7.01.41B for upgrading guardrail terminal guidelines.

3.09.03 (continued)

C. Tree Removal

Tree removal will be selective and generally "fit" conditions within the existing right-of-way and character of the road. The 2002 AASHTO ***Roadside Design Guide*** presents ideal clear zone distance criteria, however, these distances are not always practical in Michigan. Consequently, trees within the clear zone should be considered for removal subject to the following criteria:

1. Crash Frequency

Where there is evidence of vehicle-tree crashes either from actual crash reports or scarring of the trees.

2. Outside of Horizontal Curves

Trees in target position on the outside of curves with a radius of 3000 feet or less.

3. Intersections and Railroad

Trees that are obstructing adequate sight distance or are particularly vulnerable to being hit.

4. Volunteer Tree Growth

Consider removal of volunteer trees within the originally intended tree line. Volunteer trees are those that have naturally occurred since original construction of the road.

5. Maintain Consistent Tree Line

Where a generally established tree line exists, consider removing trees that break the continuity of this line within the clear zone.

6. Clear Zone

See Section 7.01.11B for Treatment / consideration of obstacles inside the calculated project clear zone. Review crash history for need for spot or corridor improvements.

3.11 (revised 2006)

FREEWAY RESURFACING, RESTORATION, REHABILITATION AND RECONSTRUCTION / NEW CONSTRUCTION (3R/4R) DESIGN CRITERIA

3.11.01 (revised 5-23-2022)

General

The 3R/4R program applies to freeways, which are defined as divided arterial highways with grade separated intersections and full control of access. Design criteria for Interstate freeways are established in the AASHTO publication, ***A Policy on Design Standards-Interstate System,*** 2005. Design criteria for non interstate freeways are established in the AASHTO publication ***A Policy on Geometric Design of Highways and Streets,*** 2011 6th Edition.

Current freeway standards for new construction and reconstruction are shown in Appendix 3A. They may, however, be flexible and performance based to more fully address the needs of all transportation modes and the challenges created by funding and ROW constraints. See Section 3.11.02D to determine when design exceptions / design variances are required. 3R freeway projects, without crash concentrations or overall not experiencing more crashes than expected for the section, must meet or exceed the minimum standards in effect at the time of the last reconstruction (or original construction if not reconstructed) for any of the ten controlling criteria. Increasing the existing value of these elements to levels below that of current 4R criteria will not require a design exception. However, if the 3R freeway project reduces the existing value of any of the ten controlling design elements further below current 4R criteria, a design exception will be required for each element reduced. Note that retaining a parabolic crown on a 3R freeway will still require a design exception (MDOT requirement). See Section 3.08.01C for information on combined 3R and 4R work.

3.11.01 (continued)

3R/4R freeway projects should be reviewed to determine need for safety improvements such as: alignment modifications, superelevation modifications, sight distance improvements, lengthening ramps, widening shoulders, flattening slopes, increasing underclearances, upgrading guardrail and bridge railings, shielding of obstacles, and removing or relocating obstacles to provide a traversable roadside. (Also see Section 3.08.01F.)

3.11.02 (revised 8-26-2019)

Freeway 3R/4R Checklist

A. Section Deleted

B. Geometrics and Signing

The Project Manager should also contact the Geometrics Unit in the Design Division and the Region Traffic and Safety Engineer to identify desirable enhancements prior to refining the project cost estimate. The Design Division – Traffic Sign Unit should be consulted to identify and coordinate plan preparation for sign upgrading needs.

C. Section Deleted

D. Design Exceptions / Design Variances

Design Exceptions / Design Variances are required whenever the design criteria given in Section 3.11.01 (Appendix 3A & minimum standards in effect at the time of last reconstruction without crash concentrations) cannot be met for controlling design elements (See Section 3.08.01E.)

3.11.03 (continued)

Safety Considerations

K. Clear Zones & Fixed Objects

The current clear zone criteria specified in Section 7.01.11 should be used when upgrading freeways. Obstacles within these limits should be shielded or removed. Obstacles beyond these limits, but within the recovery area, should be reviewed by the Geometrics Unit in the Design Division.

L. Culvert End Treatments

The ends of culverts located within the clear zone on projects programmed for upgrading shall be according to ***MDOT Drainage Manual***, Section 5.3.5.

M. Bridges

See the Bridge Management Unit, Construction Field Services Division for FHWA conformance requirements.

3.12 (revised 5-23-2022)

UNDERCLEARANCES

A. 4R Freeway

Roadway 4R projects on the Freeway System must be designed to meet the current AASHTO vertical clearance requirement of 16'-0" (16'-3" is desired for future overlay of the road). Scoping of projects must include a determination of the most effective means of obtaining the vertical clearance standard. A cost/benefit analysis to determine how best to achieve the standard, either in full or with incremental progress needs to be prepared. The analysis should include the alternatives of obtaining all vertical clearances with the road project, a bridge project, or some combination of road and bridge work to meet the clearance requirements. In many cases it may not be possible to achieve the complete vertical clearance with the proposed road project. If the most efficient plan for meeting the vertical clearance requirement is incremental progress, a design exception will be required. The design exception should be submitted as soon as possible, preferably prior to the submittal of the call for projects. This assures that design is not started on projects that may not be approved. The following is the minimum information required to prepare a vertical clearance analysis. This information is also required if a design exception is submitted.

- Preliminary grades for the bridge and approaches, the route under the structure, and ramps if appropriate.
- Location of existing structure foundations related to the proposed grade changes.
- Impact evaluation on existing drainage.
- Evaluation of any other deficient geometric feature.

3.12 (continued)

UNDERCLEARANCES

G. Vertical Clearance Requirement Table

The desired vertical bridge underclearance should be provided as indicated below. If the desired underclearance cannot be provided, then the minimum underclearance shall be met. Where it is considered not feasible to meet these minimums, a design exception shall be requested. See the vertical underclearance design exception matrix in this section and Section 12.02 of the Bridge Design Manual. Requests to further reduce the underclearance of structures with existing vertical clearance less than indicated in the chart below should be made only in exceptional cases.

VERTICAL CLEARANCE REQUIREMENT TABLE

Route Classification Under the Structure	All Construction (Desired)	New Construction (Min *)	Road 4R Construction (Min *)	Bridge 4R Construction (Min *)	3R Construction (Min *)
Freeways	16'-3"	16'-0"	16'-0"	16'-0"	16'-0" ***
NHS Arterials (Local & Trunkline)	16'-3"	16'-0"	Maintain Existing ** and 14'-6" Min	16'-0"	Maintain Existing ** and 14'-0" Min
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6"	Maintain Existing ** and 14'-6" Min	Maintain Existing ** and 14'-6" Min	Maintain Existing ** and 14'-0" Min
Collectors, Local Roads & Special Routes (1)	14'-9"	14'-6"	Maintain Existing ** and 14'-6" Min	Maintain Existing ** and 14'-6" Min	Maintain Existing ** and 14'-0" Min

* Minimum vertical clearance must be maintained over complete usable shoulder width.

** Existing vertical clearances greater than or equal to the minimums shown may be retained without a design exception. Vertical clearance reductions that fall below the minimums for new construction require a design exception.

*** Existing vertical clearances may be retained (or increased) without a design exception unless a pattern of high load hits exists. Vertical clearance reductions below the standard (table value) require design exceptions.

Information on the NHS system can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT Web site at: https://www.michigan.gov/mdot/programs/highway-programs/nfc

(1) Special Routes are in highly urbanized areas (where little if any undeveloped land exist adjacent to the roadway) where an alternate route of 16'-0" is available or has been designated. Bridges located on Special Routes in Highly Urbanized Areas can be found on the MDOT website.

Ramps and roadways connecting a Special Route and a 16'-0" route require a vertical clearance minimum of 14'-6" (14'-9" desired). Ramps and roadways connecting two 16'-0" routes require a vertical clearance minimum of 16'-0" (16'-3" desired).

Pedestrian bridges are to provide 1'-0" more underclearance than that required for a vehicular bridge. For freeways (Interstate and non Interstate), including Special Route Freeways, the desired underclearance shall be 17'-3" (17'-0" minimum).

A vertical clearance of 23'-0" is required for highway grade separations over railroads. Clearance signs are to be present for structures with underclearance 16'-0" or less (show dimensions 2" less than actual). See https://mdotjboss.state.mi.us/TSSD/tssdHome.htm for additional information and guidelines.

For shared use paths (pedestrian and bicycle) the vertical clearance to obstructions, including overhead fencing, shall be a minimum of 8'-6" (10'-0" desired). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 10'-0" is desirable for vertical clearance. See AASHTO's Guide for the Development of Bicycle Facilities.

3.12H (continued)

UNDERCLEARANCES

In addition to normal processing of design exceptions, all proposed design exceptions pertaining to vertical clearance on Interstate routes including shoulders, and all ramps and collector distributor roadways of Interstate to Interstate interchanges will be coordinated with the Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA). All exceptions to the 16'-0" vertical clearance standard on the Interstate System are coordinated with SDDCTEA. The Interstate System designated routes can be found at the FHWA NHS Maps website (https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/michigan/index.cfm). This requirement does not apply to Special Routes (1).

MDOT (or its Consultant) is responsible for coordinating exceptions on all projects regardless of oversight responsibilities. MDOT will send a copy of all requests, and responses, to the FHWA. Michigan Interstate Vertical Clearance Exception Coordination, MDOT Form # 0333, is available from MDOT web site.

3.12H (continued)

Requests for coordination shall be emailed to:
usarmy.scott.sddc.mbx.tea-hnd@mail.mil

Contact with inquiries:
Douglas E. Briggs, P.E., 618-220-5229
douglas.e.briggs.civ@mail.mil
or
Jamie Todt, P.E., 618-220-5216
jamie.l.todt.civ@mail.mil

Physical mailings:
Highways for National Defense
ATTN: SDDCTEA
1 Soldier Way
Scott AFB, IL 62225

Fax: 618-220-5125

MDOT (or its consultant) shall verify SDDCTEA receipt of the request. If no comments are received within ten working days, it may be assumed that the SDDCTEA does not have any concerns with the proposed design exception.

7.01.10 (revised 10-21-2013)

Clear Zone – History

For a number of years road designers and safety authorities considered 30' a desirable requirement for a safe roadside free of obstacles. This was based upon a study by General Motors in the early 1960's which revealed that of 211 cases at the proving grounds involving vehicles leaving the road, 80% did not travel more than 29' from the edge of pavement. The 1967 “Yellow Book” (***Highway Design and Operational Practices Related to Highway Safety***, AASHTO), page 20, rounded this distance off to 30'. The 2nd edition of the “Yellow Book”, published in 1974, reiterated the 30' distance, but called for an application of engineering judgement by emphasizing that the "30' distance is not a “magic number" (page 38). The 1977 Barrier Guide defined clear zone, in the glossary on page iv, as "That roadside border area, starting at the edge of the traveled way, available for safe use by errant vehicles. Establishment of a minimum width clear zone implies that rigid objects and certain other features with clearances less than the minimum width should be removed, relocated to an inaccessible position outside the minimum clear zone, or remodeled to make safely traversable, breakaway, or shielded."

The 1977 Barrier Guide introduced the concept that rate of sideslope, speed of traffic, horizontal curvature, and ADT would affect the width of clear zone. The 30' width was retained for 60 mph speed in combination with flat side slopes, tangent roadway alignment, and ADT exceeding 6,000. However, a graph on page 16 adjusts this basic 30' for traffic speed and rate of sideslope. These adjustments are both up or down (wider or narrower) for either descending or ascending slope. A formula on page 17 further adjusts the clear zone for horizontal curvature. Finally, a procedure shown on pages 60-65 adjusts the clear zone downward (narrower) for ADT's below 6,000. The Supplement to the 1977 Barrier Guide expanded on the clear

7.01.10 (continued)

zone criteria that begins on page 15 of the Barrier Guide by including a series of tables prepared by the state of Illinois that show clear zone requirements for various degrees of curve. These criteria have been criticized by a number of states because of the extreme clear zone widths, particularly for the combination of sharp curve, higher speed, high traffic volume and steep slope.

In anticipation of a proposed revision of the 1977 Barrier Guide, FHWA in April 1986 afforded the states a measure of relief with respect to clear zone requirements. It provided a formula for a curve correction factor that is based upon increasing the value for clear zone for a tangent section, obtained from the Barrier Guide. This new formula is more reasonable than the formula on page 17 of the Barrier Guide. It was adopted by the Department in July 1986. In 1989 the ***Roadside Design Guide*** was issued by AASHTO and adopted by MDOT as a guide. Updates to the ***Roadside Design Guide*** were published in 1996, 2002, 2006 and 2011.

7.01.11 (revised 5-23-2022)

Current Clear Zone Criteria

Virtually everyone agrees that a flat, smooth, unobstructed area adjacent to the driving lanes is highly desirable and significantly improves roadside safety. The only point of contention is how wide to make this area. The designer needs to understand that the clear zone distance is not an absolute number. Some designers have erroneously believed, that in all cases, the need for protecting motorists ends at the selected clear zone distance.

7.01.11 (continued)

Current Clear Zone Criteria

C. Clear Zone Distance Chart

CLEAR ZONE DISTANCES
(IN FEET FROM EDGE OF DRIVING LANE)

DESIGN SPEED	DESIGN ADT	FILL SLOPES			CUT SLOPES		
		1:6 OR FLATTER	1:5 TO 1:4	1:3	1:3	1:4 TO 1:5	1:6 OR FLATTER
40 mph or Less	under 750	7 - 10	7 - 10	**	7 - 10	7 - 10	7 - 10
	750 - 1500	10 - 12	12 - 14	**	10 - 12	12 - 14	12 - 14
	1500 - 6000	12 - 14	14 - 16	**	12 - 14	14 - 16	14 - 16
	over 6000	14 - 16	16 - 18	**	14 - 16	16 - 18	16 - 18
45-50 mph	under 750	10 - 12	12 - 14	**	8 - 10	8 - 10	10 - 12
	750 - 1500	14 - 16	16 - 20	**	10 - 12	12 - 14	14 - 16
	1500 - 6000	16 - 18	20 - 26	**	12 - 14	14 - 16	16 - 18
	over 6000	20 - 22	24 - 28	**	14 - 16	18 - 20	20 - 22
55 mph	under 750	12 - 14	14 - 18	**	8 - 10	10 - 12	10 - 12
	750 - 1500	16 - 18	20 - 24	**	10 - 12	14 - 16	16 - 18
	1500 - 6000	20 - 22	24 - 30	**	14 - 16	16 - 18	20 - 22
	over 6000	22 - 24	26 - 32*	**	16 - 18	20 - 22	22 - 24
60 mph	under 750	16 - 18	20 - 24	**	10 - 12	12 - 14	14 - 16
	750 - 1500	20 - 24	26 - 32*	**	12 - 14	16 - 18	20 - 22
	1500 - 6000	26 - 30	32 - 40*	**	14 - 18	18 - 22	24 - 26
	over 6000	30 - 32*	36 - 44*	**	20 - 22	24 - 26	26 - 28
≥ 65 mph	under 750	18 - 20	20 - 26	**	10 - 12	14 - 16	14 - 16
	750 - 1500	24 - 26	28 - 36*	**	12 - 16	18 - 20	20 - 22
	1500 - 6000	28 - 32*	34 - 42*	**	16 - 20	22 - 24	26 - 28
	over 6000	30 - 34*	38 - 46*	**	22 - 24	26 - 30	28 - 30

* Where a site-specific investigation indicates a high probability of continuing or higher than expected crashes, or such occurrences are indicated by crash history, the designer may provide clear zone distances greater than 30 feet as indicated. Clear zones may be limited to 30 feet for practicality and to provide a consistent roadway template if previous experience with similar projects or designs indicates satisfactory performance.

** Since recovery is less likely on the unshielded, traversable 1:3 slopes, fixed objects should not be present in the vicinity of the toe of these slopes.

13.02.05 (continued)

Clearing – Showing on Plans

CLASSIFICATION OF TREES AND BRUSH

	CLEARING	AVERAGE SPACING OF TREES CENTER TO CENTER		
CLASSIFICATION	SIZE	LIGHT	MEDIUM	HEAVY
1ST CLASS	Diameter Greater Than 36"	15' Or More	10' to 15'	10' Or Less
2ND CLASS	Diameter Greater Than 18" to 36"	20' Or More	10' to 20'	10' Or Less
3RD CLASS	6" to 18" Diameter	10' Or More	3' to 10'	3' Or Less
4TH CLASS	Brush Less Than 6" In Diameter	One Half Covered	Two Thirds Covered	Completely Covered

13.02.06 (revised 4-20-2015)

Clearing - Recheck

When more than one year has elapsed between the time of The Plan Review and the advertising date of a project, it may be necessary to request a field recheck on the clearing limits and classification of the trees and brush.

13.02.07

Clearing for Fence

Clearing for Fence is the removal and disposal of trees, brush, stumps, and other vegetation located along a fence line. It also includes treating stumps and stubs within 1' of the fence line with a material to prevent the sprouting of new growth. Maximum width of the clearing zone is 8' within the right-of-way. Measurement for Clearing for Fence will be by station.

13.02.08 (revised 5-23-2022)

Clearing and Removing Trees on Freeway 4R Projects

There are often questions raised as to the limits of tree removal and clearing on freeway resurfacing, rehabilitation, restoration and reconstruction projects. There can also be disagreement in this area among designers, planners, roadside development and the FHWA, especially along the scenic expressways of our state.

The following guidelines were developed for a 1991 resurfacing project on I-75 north of Grayling. These guidelines have the approval of FHWA and concerned Department scenic and environmental specialists.

The designer should develop a special provision based on the following guidelines, and input from the Region/TSC Resource Person, the Roadside Development Unit, and Traffic and Safety using the following criteria based on existing slopes:

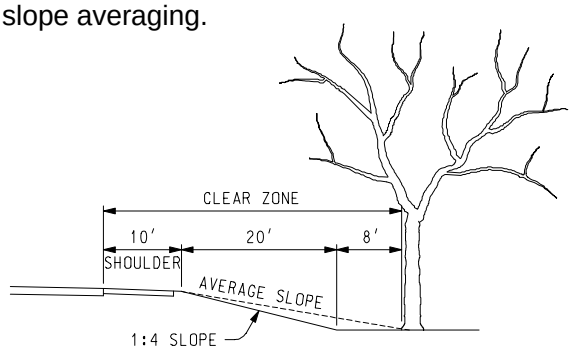
13.02.08 (continued)

Clearing and Removing Trees on Freeway 4R Projects

Slopeline	From Pavement Edge Clear to ___ feet	
	Fill slope	Cut slope
1:3		25
1:4	40	26
1:5	38	30
1:6	33	30

These distances are within the range of acceptable clear zone distances given in Table 3.1 of the AASHTO ***Roadside Design Guide***. Note that the above distances are on the mid to low side of the range of values from the table. Higher values should be considered on the outside of horizontal curves with a radius of 2900' or less or where there is a crash pattern.

Variable slopes should be averaged before applying the above guidelines. Slope averaging applies from the shoulder point out. For example: a 1:4 slope meeting a flat slope for some distance before meeting the tree line would be averaged to something flatter than a 1:4. The following sketch gives an example of slope averaging.



NOTE:
SLOPE AVERAGING IS FROM THE SHOULDER POINT OUT.

EXAMPLE:
20' AT 1:4 SLOPE = 5' DROP
8' FLAT = 0' DROP
AVERAGE SLOPE 28/5 = 5.6 SLOPE
1:4 SLOPE REQUIRES 40' CLEAR ZONE
1:5 SLOPE REQUIRES 38' CLEAR ZONE
EXAMPLE HAS 38' CLEAR ZONE WITH 1:5.6 AVERAGE SLOPE
THEREFORE THE TREES CAN BE LEFT

13.02.08 (continued)

Because of the sensitive nature of tree removal, both to the Department and to the public, good information is necessary before the design can be completed. The designer should obtain the following information:

1. Crash history covering at least a five-year period.

2. Accurate measurements from the edge of pavement to individual trees and tree lines.

3. An accurate slope survey indicating slopes and changes in slopes from the shoulder point to the trees. This information should be complete enough so that slopes can be averaged.

4. A list of environmental concerns from the Region/TSC Resources Specialist.

For additional background information the designer should refer to Chapter 3, Geometrics, Section 4 of the current edition of the AASHTO ***Roadside Design Guide*** dealing with “Trees”, and MDOT's ***"Guide to Management of Roadside Trees in Michigan"***.

14.10 (continued)

SCOPE VERIFICATION MEETING

NOTE: At this stage, the Project Manager should check to see if the project is required to be on the STIP (Statewide Transportation Improvement Plan). This may be done by accessing: JobNet

Job/CR Search (enter job number)
Approved Job
S/TIP

The ***S/TIP Indicator*** shows if the project is required to be on the STIP or TIP. The Phase tab in JobNet shows the S/TIP Cycle each phase is proposed for and the status. Project Managers needing clarification concerning the status of the STIP should contact the Region Planner or Statewide Planning Section of the Statewide Transportation Planning Division in the Bureau of Transportation Planning.

14.11 (revised 5-23-2022)

DESIGN EXCEPTIONS / VARIANCES

After the scope verification meeting is held and the project scope has been agreed upon, the Project Manager should identify any Design Exceptions or Variances (DE or DV) to MDOT standards that will be utilized in the design of the project (See Section 3.08.01E). Exceptions and Variances to MDOT design standards should be identified, and, ideally, completed during the scoping process. However, if this has not been done, a Design Exception Request (Form DE26) or Design Variance (Form DV26) should be completed. The Project Manager should consult with the Geometrics Unit of the Design Division when identifying and developing justification for design exceptions or variances. Previously completed Design Exceptions / Variances should also be reviewed for accuracy and revised at this time.

The Project Manager should request that Design Exception/Variance folders be created in ProjectWise under the project number by e-mailing MDOT-ProjectWise@michigan.gov with a link to the project or by providing the TSC and the Job Number. Consultant access to ProjectWise should also be requested at this time, if necessary. Two DE folders (MDOT and RBPI) and one DV folder will be created for each project, based on possible oversight type of Design Exception or Variance. The folders will be located under “Supporting Documents” and “Design Exception” or “Design Variance”. For each design exception/variance submitted, the Project Manager should place a single Adobe (.pdf) file (no attachments) containing the Design Exception or Design Variance Form, a predictive Highway Safety Manual (HSM) Crash Analysis, and other supporting documents into the folder which matches the project oversight Design Exception type or Design Variance. The Design Exception or Design Variance Form should be flattened or printed to Adobe (no longer fillable). However, the Project Manager should also save a copy of the fillable form for future

14.23 (revised 12-17-2018)

REQUEST FOR TRAFFIC VOLUMES
(PPD Task Description 2120)

Existing traffic volumes (ADT, DHV) for 3R projects should be requested from the Data Collection Section in the Bureau of Transportation Planning. Volumes from the latest available year should be included in the plans (Title Sheet).

Increased Capacity/New Routes (4R) projects require projected traffic volumes, usually 20 years in advance of the projected year of construction. Ordinarily these volumes have already been determined during the Project Development stage (see Section 14.05). However, if a significant period of time has elapsed, these volumes should be revised. Revisions are requested from the Project Planning Section in the Bureau of Transportation Planning. This request should be made as soon as the need becomes evident. (Traffic Analysis Request (TAR) Form 1730)

If the amount of traffic data is large (i.e. entrance & exit ramps at several interchanges), it may be desirable to show the information on a separate plan sheet.

14.24 (revised 5-23-2022)

REQUEST FOR CRASH ANALYSIS AND SAFETY REVIEW
(PPD Task Description 3560)

All projects shall have a crash analysis as called for in Section 3.08.01F conducted by the TSC or Region Traffic and Safety Engineer. The analysis may have already been completed as part of the Region/TSC's Call for Projects process, in which case an additional analysis may not be necessary. However, analyses older than 3 years should be updated by requesting another one. The analysis will identify any unusual occurrences or above expected number of crashes and will advise the Design Unit of any recommended safety countermeasures to address the situation and/or systemic improvements to incorporate within the project limits. The Project Manager should review the plans to verify these measures have indeed been incorporated into the plans prior to the FPC Meeting.

Road Safety Audits (RSA) are warranted based on the conditions defined in the Road Safety Audit (RSA) Guidance document. An RSA is a formal safety performance examination of an existing or future road or bridge project by an independent, multi-disciplinary RSA team. RSAs should be scheduled during the scoping process and are highly recommended to be scheduled prior to the Scope Verification meeting and include consideration for all users of the roadway to help achieve strategic safety goals. RSAs contribute to road safety by providing a fresh, unbiased assessment of the area or intersection to identify potential safety issues and solutions. The Project Manager (Project Owner) submits Form 3767 to request the RSA and follows the process as laid out in the Road Safety Audit Guidance to meet this requirement. RSAs are not applicable for design exceptions.

7.01.08 (continued)

Vertical Clearance

A. Requirements

VERTICAL CLEARANCE REQUIREMENT TABLE (11-28-2011) (6-22-2015)

Route Classification Under the Structure	All Construction (Desired)	New Construction (Min *)	Road 4R Construction (Min *)	Bridge 4R Construction (Min *)	3R Construction (Min *)
Freeways	16'-3"	16'-0"	16'-0"	16'-0"	16'-0" ***
NHS Arterials (Local & Trunkline)	16'-3"	16'-0"	Maintain Existing** and 14'-6" Min	16'-0"	Maintain Existing** and 14'-0" Min
Non NHS Arterials (Local & Trunkline)	16'-3"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min
Collectors, Local Roads & Special Routes(1)	14'-9"	14'-6"	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-6" Min	Maintain Existing** and 14'-0" Min

3R = Rehabilitation, Restoration, Resurfacing

4R = Reconstruction

* Minimum Vertical Clearance must be maintained over complete usable shoulder width.

** Existing vertical clearances greater than or equal to the minimums shown may be retained without a design exception. Vertical clearance reductions that fall below the minimums for new construction require a design exception. (6-22-2015)

*** Existing vertical clearances may be retained (or increased) without a design exception unless a pattern of high load hits exist. Vertical clearance reductions below the standard (table value) require design exceptions. (5-27-2020)

(1) Special Routes are in Highly Urbanized Areas (where little if any undeveloped land exists adjacent to the roadway) where an alternate route of 16'-0" is available or has been designated. Bridges located over Special Routes in Highly Urbanized Areas can be found on the MDOT website. (5-23-2022)

Ramps and roadways connecting a Special Route and a 16'-0" route require a vertical clearance minimum of 14'-6" (14'-9" desired). Ramps and roadways connecting two 16'-0" routes require a vertical clearance minimum of 16'-0" (16'-3" desired). (8-20-2009)

Information on the NHS systems can be obtained by contacting the Statewide Planning Section, Bureau of Transportation Planning or found on the MDOT website at: http://www.michigan.gov/mdot/programs/highway-programs/nfc . (5-23-2022)

Pedestrian bridges are to provide 1'-0" more underclearance than that required for a vehicular bridge. For Freeways (Interstate and non Interstate), including Special Route Freeways, the desired underclearance shall be 17'-3" (minimum 17'-0"). (11-28-2011)

A vertical underclearance of 23'-0" is required for highway grade separations over railroads when constructing a new bridge or removing the existing superstructure. For preventative maintenance, rehabilitation and deck replacement projects the existing railroad vertical underclearance does not need to be increased unless requested by the Railroad. (11-28-2011)

Clearance signs are to be present for structures with underclearance of 16'-0" or less (show dimensions 2" less than actual). See MDOT Traffic and Safety Sign Design, Placement, and Application Guidelines for additional information and guidelines. (5-23-2022)

7.01.08 (continued)

Vertical Clearance

A. Requirements

For shared use paths (pedestrian and bicycle), the vertical clearance to obstructions, including overhead fencing, shall be a minimum of 8'-6" (10'-0" desired). However, vertical clearance may need to be greater to permit passage of maintenance and emergency vehicles. In undercrossings and tunnels, 10'-0" is desirable for vertical clearance. See AASHTO's Guide for the Development of Bicycle Facilities. (9-2-2003)

B. Interstate Vertical Clearance Exception Coordination (5-23-2022)

In addition to normal processing of design exceptions, all proposed design exceptions pertaining to vertical clearance on Eisenhower Interstate System (Interstate) routes including shoulders, and all ramps and collector distributor roadways of Interstate to Interstate interchanges will be coordinated with the Surface Deployment and Distribution Command Transportation Engineering Agency (SDDCTEA). All exceptions to the 16'-0" vertical clearance standard on Eisenhower Interstate System are coordinated with SDDCTEA. The Eisenhower Interstate System designated routes can be found at the FHWA NHS Maps website (https://www.fhwa.dot.gov/planning/national_highway_system/nhs_maps/michigan/index.cfm).This requirement does not apply to Special Routes (1).
(5-23-2022)

7.01.08 (continued)

MDOT (or its Consultant) is responsible for coordinating exceptions on all projects regardless of oversight responsibilities. MDOT will send a copy of all requests, and responses, to the FHWA. Michigan Interstate Vertical Clearance Exception Coordination, MDOT Form 0333, is available from MDOT web site. (11-28-2011)

Requests for coordination shall be emailed to:
usarmy.scott.sddc.mbx.tea-hnd@mail.mil

Contact with inquiries:
Douglas E. Briggs, P.E., 618-220-5229
douglas.e.briggs.civ@mail.mil
or
Jamie Todt, P.E., 618-220-5216
jamie.l.todt.civ@mail.mil

Physical mailings:
Highways for National Defense
ATTN: SDDCTEA
1 Soldier Way
Scott AFB, IL 62225

Fax: 618-220-5125

MDOT (or its Consultant) shall verify SDDCTEA receipt of the request. If no comments are received within ten working days, it may be assumed that the SDDCTEA does not have any concerns with the proposed design exception.

7.01.08 (continued)

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or
Jamie Todt, P.E., 618-220-5216
jamie.l.todt.civ@mail.mil

Physical mailings:
Highways for National Defense
ATTN: SDDCTEA
1 Soldier Way
Scott AFB, IL 62225

Fax: 618-220-5125

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